Urban traffic congestion: its economic and social causes and consequences

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In recent years, and particularly since the early 1990s, rising transport demand and road traffic have led to increasing congestion, delays, accidents and environmental problems, particularly in large cities. This explosive increase has been the result of greater access to cars (as the purchasing power of the middle-income classes has risen), easier access to credit, falling retail prices, a larger supply of used cars, population growth, a decline in household size and an unstructured approach to urban transport policy. Transport in the largest cities consumes some 3.5% of the region's GDP, partly as a result of traffic congestion, which affects both car and public transport users and which produces a loss of economic efficiency and other negative effects for society. Without seeking to propose specific solutions, this article analyses what congestion is and what the consequences of this modern urban scourge are for city dwellers' quality of life.

I

What is congestion?

1. Popular usage and the dictionary definition

The word "congestion" is often used in relation to vehicle traffic, by specialists and the general public alike. The Concise Oxford English Dictionary (Oxford University Press, 2002) defines it as "abnormal accumulation, crowding, or obstruction, especially of traffic etc." It is commonly understood as a situation in which many vehicles are in movement and each of them progresses slowly and fitfully. These definitions are subjective, however, and not sufficiently precise.

2. A technical explanation

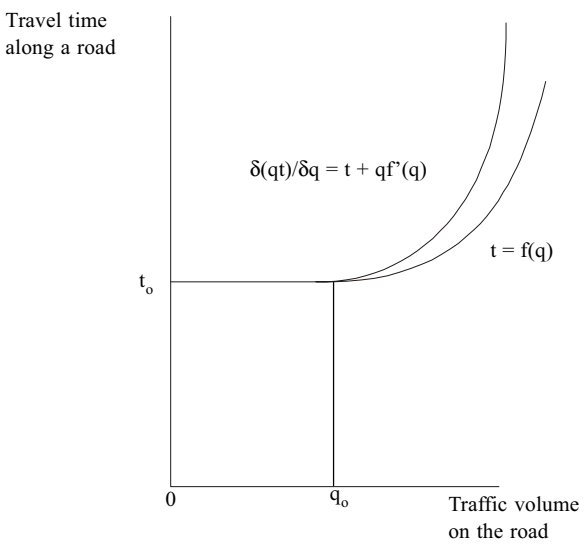
The basic cause of congestion is friction among vehicles in the traffic flow. Up to a certain level of traffic, vehicles can move fairly freely at a speed constrained only by speed limits, the frequency of junctions, etc. When volumes are higher, however, each additional vehicle hinders the movement of the rest, meaning that congestion begins. A possible objective definition, then, would be: "Congestion is the situation that arises when the entry of one vehicle into a traffic flow increases the journey time of the rest."

As traffic increases, speeds decline at a greater and greater rate. Figure 1 uses the function $t = f(q)$ to show the time *(t)* needed to travel along a street at different traffic volumes *(q)*. The other curve, $\delta(qt)/\delta q = t + qf'(q)$, is derived from the previous one. For any volume of traffic *(q)*, the difference between the two curves represents the increase in journey time that the entry of the additional vehicle causes for the other vehicles on the street.

It can be seen that the two curves coincide up to a traffic level of Oq_o; until then, the change in journey time for all vehicles is simply the time taken by the one entering, as the others can carry on moving at the same speed as before. From here onward, however, the two functions diverge, with $\delta(qt)/\delta q$ rising above t. This means that each vehicle entering the flow experiences its own delay, but at the same time increases the travelling time of all the other vehicles already on the road. Thus, the individual user perceives only part of the congestion he is causing, while the rest is experienced by the other vehicles in the flow at that time. In specialist language, it is said that users perceive the average private costs, but not the marginal social costs.

FIGURE 1

Schematic representation of the concept of traffic congestion



Strictly speaking, users do not have a thorough grasp of average private costs either since, for example, few car drivers have a clear idea of how much it costs them to make an additional journey in terms of maintenance, tyre wear, etc. However, they do perceive the costs imposed by the government (particularly the tax on fuel), which are straightforward transfers from the car user to the State, something that has a distorting effect on their decision-making.

Another conclusion, which is borne out by simple observation, is that at low congestion levels an increase in the flow does not significantly raise journey times, but at higher levels the same absolute increase raises total travelling times considerably.

In accordance with the definition given, congestion begins at traffic volume Oq_o. This generally happens at relatively low volumes, however, which does not accord with the popular understanding of the concept.

3. Towards a practical definition of traffic congestion

Some specialist texts do not give very rigorous definitions of congestion. Two renowned transport modelling specialists consider that "congestion arises when demand levels approach the capacity of a facility and the time required to use it (travel through it) increases well above the average under low demand conditions" (Ortúzar and Willumsen, 1994). Although it matches the public perception, this definition gives no indication of the exact point at which the phenomenon begins.

One effort to define the term precisely in a way that matched normal perceptions was made in a bill to introduce road charging passed by the Lower Chamber of the Chilean Congress. As the intention was to avoid leaving the authorities any room to act discretionally, the definition was highly specific. A road was deemed to be congested when along more than half its total length (the sections need not be consecutive) the average spatial velocity of the traffic flow was less than 40% of the free flow speed. This condition had to prevail for at least four hours a day from Tuesday to Thursday, as ascertained by surveys taken over four consecutive weeks between March and December. An exact definition of congested areas was also considered.[1] The definitions were perhaps too precise and difficult to apply in practice, although in fact there has been no occasion for it to be applied so far since the bill has not received legislative approval from the Senate.

Without going into so much detail, but in the same spirit of objectivity, we might define congestion as "the condition in which the introduction of one vehicle into a traffic flow increases the delay for the remainder by more than *x%*". An objective, albeit still arbitrary, definition of congestion might be a volume of traffic such that $\delta(qt)/\delta t = at$, where for example $a = 1.50$. In other words, congestion would begin at the point where the delay to which all vehicles already in the traffic flow were subject equalled half the travelling time that an additional vehicle would have.

II

Causes of congestion

1. The characteristics of urban transport that cause congestion

The transport system, including the provision of urban land for transport infrastructure, operates under very special conditions, among which mention may be made of the following:

— The demand for transport is derived and not an end in itself (Ortúzar and Willumsen, 1994). Journeys are rarely made because of a desire to travel as such; they generally result from the need to go to places where different activities are carried out (such as work, shopping, study, recreation, leisure, etc.), all of them in different locations.

— The demand for transport is highly variable and there are very marked peaks when many journeys coincide, owing to people's wish to use the day to the full to carry out their different activities and have the opportunity to make contact with others.

– Transportation takes place along restricted road spaces that are fixed in the short term. It will readily be understood that unused road capacity cannot be stored for later use in periods of higher demand.

— The transport options that have the most sought-after characteristics –i.e., safety, comfort, reliability and autonomy, as is the case with the car– are the ones that use most road space per passenger, as will be explained later.

— The provision of road infrastructure to meet demand at peak times is very expensive, particularly in urban areas.

— Because of these factors, congestion occurs in various places, with all the adverse effects this has in terms of pollution, substantial expenditure of private and social resources, and diminished quality of life.

An aggravating factor, as was indicated in the previous section, is that the cost of congestion is not fully perceived by the users who contribute to it. Whenever this happens, the good or service concerned

[1] Chilean bill aimed at establishing a charge for use of urban roads affected by vehicle congestion.

is consumed more than the social optimum. Since users do not experience the greater time and operating costs they are causing to others, their decisions about routes, mode of travel, origin, destination and the times at which they make their journeys are taken on the basis not of the social costs, but only of their own costs or, more precisely, of what is often an incomplete perception of those costs. The logical outcome is overuse of existing road infrastructure, at least in particular areas and at particular times.

2. The problem is caused mainly by cars

Some vehicles generate more congestion than others. In traffic engineering, each type of vehicle is rated by its PCU (passenger car unit) equivalence. A car scores 1 PCU, while other types of vehicle receive a rating that reflects the disruption they cause to the traffic flow, or the road space they effectively occupy, by comparison with a car. A bus is normally considered to score about 3 PCU and a lorry about 2 PCU. Strictly speaking, the PCU factor varies depending on whether the vehicle is approaching an intersection or is on a stretch of road between intersections.

Although a bus generates more congestion than a car, it generally carries more people. If the former carries 50 passengers and the latter an average of 1.5, then each car occupant is causing 11 times as much congestion as is attributable to each bus passenger. Other things being equal, then, congestion will fall if buses come to account for a larger share of journeys. Unless they carry less than 4.5 passengers, they will on average cause less congestion than cars. It is unusual for buses to carry less than 4.5 passengers, but it can happen, as for example in areas of Santiago, Chile, at off-peak times in the late 1980s, or in Lima 10 years later.

An excessive number of public transport vehicles worsens congestion, as can be seen in some cities. One of the characteristics of today's economic models is deregulation. In the area of urban passenger transportation, far-reaching deregulation normally results in a considerable expansion of bus and taxi fleets and a deterioration in the orderliness and discipline of their operations. This made a major contribution to higher congestion in Santiago in the 1980s and in Lima the following decade.

Liberalization of used vehicle imports and deregulation of public transport took place simultaneously in Lima, with particularly severe effects. In Santiago, which had some 4.3 million inhabitants in the late 1980s, used vehicle imports were rare and the public transport fleet (buses of all kinds and collective taxis) did not exceed 16,000 units. In the mid-1990s, however, the public transport fleet in Lima, which then had some 6.7 million inhabitants, numbered at least 38,000 units (although some sources put the actual figure at close to 50,000). In other words, in the mid-1990s the number of units per inhabitant in Lima was between 52% and 101% higher than it had been in Santiago some seven years before, just when deregulation in Chile was producing its most dramatic results.

3. Driving practices and the state of roads contribute to congestion

a) *Roads in cities: design and maintenance problems*

Poor road design and maintenance result in unnecessary congestion. In many cities it is common to come across stretches of road without lane markings, unexpected changes in the number of lanes, bus stops situated just where the roadway narrows, and other shortcomings that obstruct the traffic flow. Poor pavement conditions, and potholes in particular, create growing capacity restrictions and increase congestion. In many Latin American cities, such as Caracas, rain gathering on the road surface reduces capacity and thus increases congestion.

b) *Some types of behaviour cause more congestion than others*

Some drivers show little respect for other road users. In certain cities, such as Lima, many drivers try to save a few seconds' journey time by cutting in at junctions, thus blocking them and generating diseconomies for others that are much greater than the benefit they obtain for themselves. In other cities, such as Santiago, it is customary for buses to stop immediately before junctions, which causes congestion (and accidents). And in these cities and others where there is an ample supply of taxis that do not usually operate from fixed stands, the drivers of these vehicles cruise slowly on the look-out for passengers, which also causes congestion.

In addition to all this, traffic flows often include old, poorly maintained or animal-drawn vehicles. When vehicles start moving again after stopping at traffic lights, congestion is caused by the delay that slower vehicles in front impose on vehicles with normal rates of acceleration behind them. A broken-down vehicle severely obstructs the traffic flow, as it effectively closes a whole lane.

c) *The information available on traffic conditions is inadequate*

Another factor that increases congestion is ignorance of traffic conditions. If a motorist who can reach his destination by either of two routes, A and B, knows that traffic conditions are poor on route A, he can use B, where his own contribution to congestion will be less. A study of a hypothetical city conducted at the University of Texas shows that being informed about traffic conditions in the different parts of the network can reduce congestion by much more even than road charging can (IMT, 2000). Lack of basic knowledge of the street network could also increase the average mileage of each journey and contribute to congestion.

d) *Reduced capacity is the result*

Generally speaking, the combination of motorist behaviour and the state of roads and vehicles undoubtedly means that a street or urban network in Latin America has a lower capacity than one of the same geometrical dimensions in Europe or North America. Evaluations carried out in Caracas in the early 1970s established that a motorway there had just 67% of the capacity of a similar-sized one in the United States.[2] This percentage difference must vary from one city to another, but there can be no doubt that, relatively speaking, the propensity towards congestion in the road systems of Latin American cities is generally high.

III

The invasion of the car

The last decade of the twentieth century brought with it a large increase in the number of cars in use in Latin America. These vehicles are employed for the most varied purposes, including travel to places of work and study, and this is placing substantial pressure on the road network. What is the cause of all this?

1. Economic reforms have made car ownership more accessible

The economic reforms implemented in the region in the 1990s led, among other things, to higher economic growth rates and lower car prices. Growth rates per inhabitant were almost invariably negative in the 1980s, but they turned quite strongly positive in the 1990s. In Uruguay, for example, average annual growth rose from -1% between 1981 and 1988 to 4% between 1991 and 1994 (ECLAC, 1989 and 1995). This has had a favourable impact on personal incomes, leaving more money free to spend on durable goods.

At the same time, taxes on cars, particularly customs duties, were cut in many cases. In some countries, furthermore, the exchange rate appreciated, making imported products cheaper. In Colombia, for example, the real exchange rate in 1994 was just 75% of its 1990 level (IDB, 1995).

This tendency has not always resulted in lower prices, because vehicle quality has also been improving. In the case of vehicles whose characteristics have remained relatively constant, however, retail prices have fallen in real terms. In 1996, for example, the selling price of a Volkswagen Beetle in the Chilean market was equivalent to US$ 7,780. In 1982, it would have cost US$ 8,902 at 1996 prices.

Prices for used cars have clearly fallen by even more in real terms, although reliable data are very hard to obtain. The rate at which cars depreciate is directly related to the ownership rate. In countries where there are few vehicles per person, second-hand cars are quite scarce and selling prices reflect the limited supply, while demand is sometimes high. The increase in vehicle ownership levels in Latin America over recent years has eased the relative scarcity of used cars, thereby tending to increase supply, reduce demand (since a larger proportion of inhabitants already own a car) and thus bring down prices, putting them within reach of lower-income families.

As a result, while real incomes in Latin America are rising, car prices are tending to decline.

2. The popularization of car ownership

In Latin American cities, changes in personal incomes and car prices, particularly prices for used cars, have meant that vehicle ownership is ceasing to be an

[2] Figures calculated by the authors on the basis of data from Voorhees (1973) and Winfrey (1969).

unattainable dream and is becoming a reality for many families. The increase in the car ownership rate is a phenomenon that can be seen virtually throughout Latin America, and it has enabled the middle class, in particular, to harvest one of the most important fruits of technological progress in the twentieth century.

In countries where economic reform was implemented quickly, car imports likewise grew at a rapid pace (table 1). The column for Peru in the table shows that between 1990 and 1991 car imports increased 14-fold in value. Peru liberalized imports not only of new cars, but of used ones as well (except for a brief period between February and November 1996). The average unit price fell as a result, indicating that the number of units imported rose by more than import costs.

In some car manufacturing countries the economic reforms resulted in both imports and domestic vehicle production rising. This happened in Brazil, where for decades car imports were subjected to heavy tariffs as part of a policy of encouraging domestic production. Between 1990 and 1994, imports grew by more than 10,000%, albeit from a tiny base. Domestic output also rose by 70%, however. Exports were restrained because producers preferred to place their output in the growing domestic market (table 2). For a time from mid-1994 onward, the appreciation of the country's currency also had an effect. One concrete result is that while the population of São Paulo grew by 3.4% between 1990 and 1996, the number of vehicles in the city grew by 36.5%.

On the basis of data for the 34 communes in Greater Santiago, the following equation for determining the number of cars per family was derived:

$$y = e * (0.2850 - 134.5746/X)$$

where y = cars per family and x = monthly income per family in 1990 pesos.

This equation has the expected form, although there could be technical objections to it.[3] It can be used to estimate the elasticity or unit variation of the car ownership rate in relation to income. Table 3 shows that elasticity has an inverse relationship with income levels. While elasticity in low-income communes (*La Pintana*) may be very high, a 1% rise in incomes translates into a small increase in the absolute number of cars per family. A 1% rise in incomes in a middle-income commune, meanwhile, translates into a rise in the absolute number of cars per family that is very similar to that seen in a very high-income commune.

The most important conclusion that can be drawn from this analysis is that a rise in incomes substantially increases car ownership rates not just in higher-income neighbourhoods but in middle-income ones as well. Thus, the number of cars in Santiago grew at an annual rate of 8% during the 1990s.

TABLE 1

Ecuador and Peru: Passenger vehicle imports[a]
(*Thousands of dollars*)

Year	Ecuador[b]	Peru
1989	10,062	6,482
1990	23,432	11,880
1991	23,554	170,668
1992	166,109	213,018
1993	245,895	165,647
1994	374,038	252,421

Source: ECLAC, on the basis of official information.

[a] The figures exclude buses.
[b] The figures relate specifically to private transport vehicles within the consumer goods category.

TABLE 2

Brazil: Apparent car consumption[a]

Year	Units		Apparent car consumption[a]
	Imported	Produced	
1990	1,310	602,545	483,084
1991	11,146	615,097	499,090
1992	30,714	667,229	454,817
1993	70,438	929,582	750,413
1994	138,679	1 026,827	890,691
1995	320,261	1 147,897	1 278,437

Source: ECLAC (1997).

[a] Production + imports - exports.

3. Cars are fewer, but travel seems harder

The growing number of vehicles is undoubtedly increasing the tendency towards congestion.

[3] The equation was adjusted (r = 0.9586) on the basis of commune-level data compiled in a cross-sectional type transport survey conducted in 1991. The changes in the car ownership rate estimated by the equation are only a function of the change in family incomes; they do not reflect the influence of changes in car prices or quality, as these factors remain constant in a cross-sectional analysis. In fact, prices have tended to fall and vehicle quality to rise, so that the increases in ownership rates over the years are higher than the equation predicts.

TABLE 3

Santiago, Chile (three communes): Estimated increase in car ownership per family as average incomes rise

Commune	Monthly family income	Cars per family	Elasticity of cars per family in relation to family income	Increase in cars per family if family incomes rise 1%
Vitacura	598,700	1.71	0.23	0.0039
Santiago (centre)	126,700	0.311	1.06	0.0033
La Pintana	39,730	0.051	3.39	0.0018

Source: Authors' estimate based on statistics provided by Kain and Liu (1994), table A-7. The authors do not mention the source of their data, but they doubtless come from the 1991 origin-destination survey conducted in Greater Santiago by the Executive Secretariat of the Commission of Investment Planning for Transport Infrastructure (SECTRA).

Nonetheless, car ownership rates in Latin American cities are still generally much lower than those seen in developed countries. In 1980, the number of cars per person in North American cities such as Houston, Los Angeles, Phoenix, San Francisco, Detroit, Dallas, Denver, Toronto and Washington was between 0.55 and 0.85, while in European cities such as Brussels, Amsterdam, Copenhagen, Frankfurt, Hamburg, London, Stuttgart and Paris the rate was between 0.23 and 0.43. Some 10 or 15 years later, some Latin American cities (such as Chiclayo and Huancayo in Peru) still had no more than 0.02 cars per inhabitant. In Lima, the rate was no more than 0.05 per person, even though the surge in vehicle imports had then begun. In Greater Santiago there were 0.09 per person. Again, in a small number of Latin American cities the ownership rate was closing in on the lower limit for Western European cities. In Curitiba, for instance, there were about 0.29 cars per person in 1995.

Despite this, there is evidence that it is easier to drive around large cities in the developed world than comparable ones in Latin America. In Quito, whose 1990 population was roughly a million, the average journey time from home to the workplace was 56 minutes; in Munich, with its 1.3 million inhabitants, it was 25 minutes. In Bogotá (five million inhabitants) the journey time was 90 minutes, while in London (6.8 million) it was 30 minutes. There are many similar examples. It is clear that the cities of the developed world are better equipped to live with the car and avoid its worst consequences, something that Latin America has yet to master.

It also seems to be easier to drive around the Latin American cities that have the highest rates of car ownership than in many of those that have lower rates. Curitiba, for example, has more cars per person than Guatemala City, which is of similar size, but travelling by car or public transport is a much less unpleasant experience in the former than in the latter.

The explanation for these apparent contradictions has to be sought in the marked tendency to use cars intensively for every kind of purpose.

4. Subjective factors are also important

What underlies or accounts for the marked preference for private vehicle use?

One important aspect is "status". In Latin America, cars are still regarded not just as a means of locomotion but as an indicator of their owner's position in society. Someone who drives a BMW is deemed superior to someone who drives a Suzuki. Someone who arrives at the office by car instead of by bus is considered to have risen in the social scale. The prestige associated with car use has a major impact on traffic volumes.

In addition to these reasons, which relate to the social structure and cultural characteristics, the following are some of the other considerations that have an influence in Latin America:

— The poor quality of buses, when measured against the aspirations of car owners.
— The high rates of bus occupation at peak times.
— The safety worries caused by the aggressive driving methods of some bus drivers.[4]
— The possibility, real or presumed, of falling victim to crime on board public transport vehicles.

[4] A telephone survey held in March 2001 in Santiago, Chile, revealed that 63% of public transport users believed buses to be unsafe in terms of the risk of road accidents, while 70% said they were driven recklessly (published by the electronic newspaper El Mostrador, 2001).

The preference for car use becomes a problem at peak times, when most travel for work and study takes place. Not even long delays can induce people to stop using their cars. Given the choice between arriving at their destination slowly on congested roads or somewhat faster in public transport, it is far from certain that many Latin American car users would opt for the second alternative.

The inhabitants of cities in the developed world are less inclined to use their cars to drive to the office in the morning rush hour. Clearly, a distinction is made between ownership of a car and its use in situations involving major difficulties. A New York or London banker living in the suburbs of the city would never dream of travelling to Wall Street or the City by car each day, since both cities have good-quality public transport systems. Their counterparts in São Paulo or Santiago would not consider travelling to the centre other than by car.

The preference for car travel can bring other consequences that affect more than just the transport sector as such, with negative macroeconomic implications. Consider, for example, the increases in car fuel prices resulting from the rise in international oil prices in 1999 and 2000. Typical Latin American car owners probably did not much reduce their vehicle use, but cut back on consumption of other goods and services instead, thereby reducing short-term demand for these, many of which are produced locally. At the same time, higher prices and inelastic demand meant that the amount of currency that importing countries had to give over to fuel purchases increased.

IV

How serious is the problem, and who suffers from it?

1. Different indicators reveal a bad and worsening situation

Taken as a whole, urban transport is of great importance to a country's development. The operation of vehicles on the roads of cities with more than 100,000 inhabitants consumes some 3.5% of Latin America and the Caribbean's gross domestic product (GDP), without considering optional journeys, like those made at weekends. The social value of the time spent travelling equates to a further 3% or so of GDP. As these figures show, the resources applied to urban transportation are very substantial.

These percentages are very likely to rise, for a number of reasons. Firstly, the increase in vehicle ownership rates already mentioned, and the tendency for cars to be used intensively. Secondly, cities are growing, and journey lengths are increasing as a result (Thomson, 2001).

Inevitably, growing demands on a relatively unchanging supply of roads will result in a progressive reduction in journey speeds. The situation is worsening rapidly, as is revealed by the form of the statistically obtained equations relating traffic speed with traffic volume in a street.

At peak times, much of the road network in Latin American cities is operating very close to capacity, which means that small increases in traffic flows have a very severe effect on congestion. Although there are not many figures showing specifically how congestion has developed over the years, data for São Paulo reveal that in 1992, on average, some 28 kilometres of the main road network suffered from acute congestion in the mornings and 39 kilometres in the evenings; by 1996, the number of kilometres affected had risen to 80 and 122, respectively (Companhia de Engenheria de Tráfego, 1998).

The case of Santiago, Chile, is interesting because it is the capital of the Latin American country where the economic reform and liberalization process began. Simulations indicate that the average time taken to travel 10 kilometres by car during the rush hour rose from 22 to 32 minutes between 1991 and 1997 (ECLAC, 1997). Furthermore, the most acute congestion is no longer found just in the wealthiest communes, but in some middle-income ones as well. The highest-income neighbourhoods are in the north-east of the city. There is congestion in this area, and along the thoroughfares between it and the city centre. The most congested places, however, include thoroughfares in other parts

of the city where family incomes are much lower and which are not even transit areas for high-income vehicle users.

As regards the cost of the congestion caused, for conditions in Caracas in 1971, when the situation was less serious than it is now, it was calculated that each car occupant generated a congestion cost of US$ 0.18 per kilometre (in 2000 prices) and each bus passenger a cost of US$ 0.02 per kilometre.[5]

It seems reasonable to conclude that congestion costs are high and, conversely, that the adoption of low or moderate cost measures to reduce congestion would have substantial net benefits. Conservative calculations suggest that increasing car travelling speeds by 1 km/h and public transport speeds by 0.5 km/h on average would reduce journey times and operating costs by an amount equivalent to 0.1% of GDP (Thomson, 2000b).

In any event, merely measuring traffic speeds or quantifying congestion costs does not fully capture the extent of the problem. To limit the effects of congestion, some people change their behaviour, adopting habits that are not what they would ideally choose, such as leaving home very early to travel before peak congestion times or living close to their workplace.

In addition to all this, there are other serious consequences that have a severe effect on urban living conditions, including greater air pollution caused by high fuel consumption in vehicles travelling slowly in clogged traffic, higher noise levels in the vicinity of major thoroughfares, the irritability caused by the loss of time and the additional stress caused by driving on crowded roads. These other results of congestion may be difficult to quantify, but they should not therefore be overlooked, since they aggravate what is already a serious situation.

2. Who pays the costs of congestion?

Firstly, it has to be said that the prejudicial effects of congestion fall upon all city dwellers, in the form of lower quality of life in different respects (greater noise and air pollution, negative impact on mental health, etc.). Thus, in one way or another, nobody is immune to its consequences.

If the analysis is focused on those who have to travel, the effects of congestion can be analysed by breaking down its costs into two basic components: people's time, and vehicle operating costs, particularly fuel. Both costs are increased when journeys are undertaken in congested conditions.

It is unquestionable that car drivers themselves have to bear the consequences of congestion. In other words, they experience the effects of what they themselves have caused, in the form of longer travelling times and higher operating costs.

Car drivers are not the only ones to suffer the effects of congestion, however. Congestion worsens the already poor condition of public transport, whose users are thus seriously affected by it as well, even though they do not cause it. This is a source of social inequality, as public transport is mainly employed by people with lower incomes, who are captive users.

a) *Congestion delays bus passengers*

Congestion obviously makes journey times longer for bus passengers. This is unquestionably detrimental to them, but perhaps does not attract too much attention because the relatively low incomes of these passengers mean that a low monetary value is set on their time.

In Latin America, particularly, urban bus users have much lower incomes than urban car users. In Santiago, Chile, analysis of the data generated by the 1991 origin-destination survey yields a figure of 99,321 Chilean pesos (CLP) for the family incomes of bus passengers and a figure of CLP 308,078 for car users. In other words, the incomes of car occupants are typically more than treble those of bus passengers. Data for São Paulo in 1977 indicate that, on the whole, the situation there was no different from that in Santiago (table 4), and if measurements existed for other cities in the region the conclusion would probably be similar.

TABLE 4

São Paulo: Relative incomes of users of different modes of transport, 1977
(*Car = 100*)

Mode of transport	Relative income of users
Bus only	55
Car only	100
Taxi only	91
Metro only	89
Suburban train only	39
Bus + bus combination	50
Bus + metro combination	62.5
Bus + train combination	50

Source: Empresa Metropolitana de Transporte Urbano de São Paulo.

[5] Estimates based on Thomson (1982).

b) *Congestion increases bus fares*

Another factor, which many passengers might consider more important than longer journey times, are bus fares. Congestion delays not only bus passengers, but the buses themselves. As a result, more units and more drivers are required to provide the same transport capacity, the result being higher fares.

This phenomenon was analysed by ECLAC in 1982, when it was estimated that if the speed at which public transport travelled around Santiago increased from 15 to 17.5 km/h at peak times, fares could be cut by up to 5% (Thomson, 1982). A more recent study on the largest cities in Brazil estimated that congestion increased bus operating costs by up to 16% (table 5). Note that the percentages are very low in the cases of Brasilia, which is exceptionally well endowed with road space, and of Curitiba, where buses operate on dedicated lanes.

TABLE 5

Brazilian cities: Increases in public transport operating costs as a result of vehicle congestion
(*Percentages*)

City	Increase in bus operating costs due to congestion
Belo Horizonte	6.2
Brasilia	0.9
Campinas	6.4
Curitiba	1.6
João Pessoa	3.7
Juiz de Fora	2.1
Recife	3.5
Rio de Janeiro	9.6
São Paulo	15.8

Source: ANTP (1999).

Under year 2000 conditions, after almost 20 years of real increases in the prices of buses and drivers' wages, a reduction of 10% would surely be feasible.

V

Dealing with the situation

Traffic congestion, especially in large cities, is becoming more and more common throughout the world. The huge and growing costs in time and vehicle operating expenses that it entails mean there is a need to design policies and measures to help bring it under control. The problem is complex, and the most appropriate solutions are difficult to design.

1. Some congestion is desirable

In urban areas, particularly at times of greatest demand, congestion is inevitable and, within limits, desirable, since the costs it entails may be lower than the costs that would have to be incurred to eliminate it. Attempting to banish congestion entails the following costs, among others:

— The costs of diverting users on to other routes or to other modes or times of travel.
— The costs of suppressing certain journeys.
— The costs of investment to increase road capacity, which may be greater than those caused by moderate levels of congestion.

Underuse of road space already available also represents a loss of benefits for society.

The idea, then, should not be to get rid of congestion entirely, since this would be impossible or very expensive, and is not even desirable. It does have to be kept under control, though, since rising congestion has a negative impact on quality of life in large cities.

2. A fresh approach by the authorities

In almost all the region's cities, travelling conditions have worsened by much more than they might or should have done, something that is partly due to mismanagement by the authorities concerned. It is plain that the growth in private vehicle numbers has far outstripped the capacity of institutions to deal with the situation.

Hitherto, the reaction of the authorities has been uncoordinated because, throughout the Latin America region, responsibility for planning and administering urban transport is divided up among a whole array of bodies: different national ministries, regional governments, municipalities, suburban or underground railway companies, traffic police, etc. Each of these does what it thinks best without much considering the repercussions for the interests of the other institutions.

A municipality, for example, fearing that economic activity may be diverted away to another part of the city, might authorize the construction of car parking facilities or allow on-street parking, without concerning itself with the impact the congestion generated will have on road users travelling through the area.

Another situation reflecting the consequences of piecemeal decision-making that fails to take account of the wider repercussions may arise in the vicinity of a mass transport facility, such as a metro. Because accessibility has increased, land use becomes denser, and office buildings are put up. Municipal rules generally require these buildings to have a minimum number of parking places of their own; as a result, staff are encouraged to come in by car. This set of measures tends to increase congestion.

Furthermore, in an area as sensitive as urban transport, strong pressure is applied by organized groups, such as road hauliers, and by politicians pressing home their points of view and, on occasion, defending particular interests. All this is a source of distortion and makes the situation even more involved.

The speed with which traffic congestion is increasing in the region's cities makes it imperative for the authorities to adopt a new approach so that urban transport systems can be adapted to this situation, particularly as regards the use of cars in congested areas or at peak times. Institutions need to improve their ability to respond –and more importantly still, to anticipate– in an effective way. They also need to develop the capability to cope with the pressures that are applied from so many sides.

What is required then are, firstly, increased professional and specialist traffic management capabilities, both in the authorities responsible and in universities and local consultancies, and secondly, traffic management that is integrated and not divided up institution by institution.

3. There is a place for private transport, but only within reason

One thing that makes it difficult to combat congestion in Latin America is the marked preference of city dwellers for the car. In these circumstances, even if the authorities responsible for urban transport in Latin America had clear ideas about how traffic should be controlled in cities (which unfortunately is not always the case), it would be hard for them to put these into effect because parliamentarians or city councillors, fearful of losing votes among the ever-growing ranks of private car owners, would not give their approval.

The preference for car travel has a number of consequences, including the following:

— The demand among car users for new high-quality public transport systems could be quite low, so that most users of a new metro line would be drawn from among bus passengers rather than private vehicle users;
— For car users to become interested in public transport they would have to be offered a superior option, not only in terms of objective quality (fares, travel time and frequency) but also in terms of subjective attributes (air conditioning, reclining seats, etc.).
— Even if fuel, road use or parking were highly taxed, few people would switch from cars to public transport. As a result, i) these measures would be more a way of raising revenue than of changing traveller behaviour and ii) raising these taxes would yield a high fiscal return, but would produce relatively few social benefits.

Using a car to go to a shopping centre, to visit relatives or friends living some distance away or to get out of the city is one of the fruits of economic development; many of the costs are usually internalized by the owner of the vehicle, insofar as these journeys take place at times of low congestion. Using a car to go to a city centre office every day, however, generates external costs in the form of congestion and pollution and does society considerable harm.

Striking a better balance between car ownership and use is one of the greatest challenges now facing the region's transport sector. It is likely that there will be a change in attitude among car owners in future, and in some more culturally developed cities –such as Buenos Aires, where the quality of public transport is also higher than the average for Latin American cities generally– it can be seen that there is already a greater willingness to use public transport than in some other Latin American cities.

4. A comprehensive approach is needed

Congestion is too serious and overwhelming a problem for there to be any prospect of it being mitigated by unilateral, inconsistent or unrealistic measures. On the contrary, if it is to be kept under control and if urban living standards are to be at all sustainable, there is an urgent need for an interdisciplinary effort that includes measures to improve driving habits, the provision of better infrastructure (supply management) and traffic management measures (demand management).

Urban roads in Latin America do not have the capacity to cope with indiscriminate private vehicle use, and they never will, even if all financially, environmentally and politically feasible measures are taken to expand them. Merely providing more road infrastructure does not solve the problem; in fact, it can make it worse, as the experience of Caracas and other large cities that have applied this strategy shows.

Nonetheless, improving roads and perhaps enlarging them can potentially be useful, provided these measures are matched by others to prevent them rapidly clogging up, or the congestion being transferred a few blocks along.

Better results can be expected from simultaneous, progressive action on a wide range of transport fronts: good street marking and maintenance, coordination of traffic lights, better driving habits, rationalization of public transport and car parking, awareness of the larger traffic volumes generated by new buildings and shopping centres, and many others. It must never be forgotten that any particular measure can have repercussions for other aspects of vehicle traffic, and negative effects can be forestalled if these repercussions are anticipated.

In other words, a set of feasible measures needs to be implemented to increase capacity by improving management and enhancing the productivity of existing infrastructure.

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